

Viruses provide direction on the plant information superhighway: a viral movement protein helps to identify a counterpart in plants

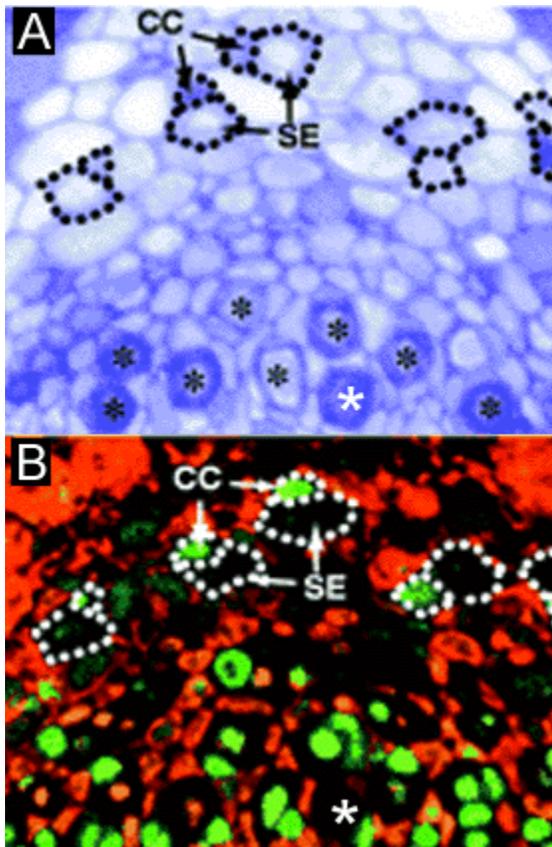
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The phloem is the long-distance transport system of plants. In addition to distributing nutrients, the phloem plays a role in transporting hormones and signaling proteins. The phloem, together with the xylem, which transports water and dissolved ions, provide the plant with its internal trafficking system. Phloem tubes are made up of aligned cells, called sieve elements, which lack nuclei and therefore must rely on associated companion cells for physiological support and nourishment. Sieve elements and companion cells are connected by plasmodesmata — a network of tiny channels through which molecules such as sugars, hormones and amino acids travel. How these molecules are ushered via plasmodesmata into the long-distance transport systems has eluded researchers until only recently, when viruses have provided some vital clues. Plant viral movement proteins (VMPs) have been known to exist for some time. These are proteins encoded by the virus that assist in the transportation of the viral nucleic acid around the plant. Their exact mode of action, plus the requirement (or otherwise) for coat proteins for systemic infection can vary from virus to virus. For example, cytoplasmically replicating viruses (e.g. tomato spotted wilt virus) require one or more movement proteins and a coat protein, while bipartite geminiviruses (e.g. squash leaf curl virus) require two movement proteins, but no coat protein.

The virus that has recently shed light on the plant transportation mechanism is red clover necrotic mosaic virus (RCNMV), which uses a single virus-encoded movement protein to move between cells. This VMP binds to viral RNA, and, using host-cell microfilaments, chaperones the viral RNA to the plasmodesmata. Once at the plasmodesmata, the VMP acts to somehow increase the diameter of these channels, permitting the viral nucleic acid to enter the adjoining cell. However, in order to infect a plant systemically, the red clover necrotic mosaic virus RNA must first be encapsulated by its protein coat.

Recently, a plant protein, CmPP16, isolated from *Cucurbita maxima* (winter squash), was discovered that was reported to share sequence similarity with the red clover necrotic mosaic virus VMP. If so, this suggests that CmPP16 may assist in the long-distance transport of plant RNA, using a similar mechanism to the red clover necrotic mosaic virus VMP.

Why transport RNA around the plant? One possibility is that the RNA is being used as a long-distance signaling molecule, helping to coordinate developmental processes with physiological signals. Looking at how viruses spread throughout a plant could assist in the fascinating puzzle of how different parts of the plant talk to each other.



mRNA was detected within the vascular tissue of *Cucurbita maxima* or winter squash (A) This image of a transverse section of winter squash depicts the various components of the phloem. Black dots outline companion cells (CC) and sieve elements (SE) joined by fine, branched plasmodesmata. Black asterisks identify immature sieve elements; the white asterisk reflects the identical cell in images (A) and (B).

(B) *CmPP16* mRNA (green fluorescent signal) is shown to have moved within the phloem. mRNA was found mostly in companion cells, but also in mature, functional sieve elements suggesting its movement through plasmodesmata.

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Important Links

Live PubMed searches

- (1) Plasmodesmata AND RNA transport
- (2) Long-distance transport in plants
- (3) Viral movement proteins of RCNMV

Additional NCBI resources

Taxonomy: *Cucurbita maxima* [<http://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=3661&lvl=3>]

Taxonomy: red clover necrotic mosaic virus [<http://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=12266>]

Box: Search PubMed for RNA transport in plants

Click on the link below to start an html tutorial.

Why is RNA transported around plants? [http://www.ncbi.nlm.nih.gov/Coffeebreak/CB11_VMP/PQ.html]

Box: Use BLAST to search for proteins similar to CmPP16

Click on the link below to start an html tutorial.

Search for proteins similar to CmPP16 [http://www.ncbi.nlm.nih.gov/Coffeebreak/CB11_VMP/BQ.html]